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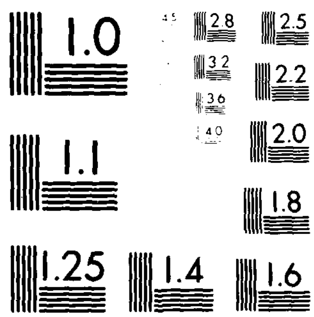

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November 1981

DIAGNOSTICITY AND THE BASE-RATE EFFECT

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MAYA BAR-HILLEL

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NOTES

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A common judgmental task involves predicting the category membership of an individual on the basis of information specific to that individual and background information regarding the base rate of different categories. According to statistical theory, predictions may deviate from base rates only to the extent that the individuating information is diagnostic. Previous research has demonstrated that diagnosticity is often judged by "representativeness," the degree to which the individuating information is differentially suggestive of

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the different possible categories. Thus, information with high differential representativeness, even if it is worthless (e.g., because its sources are unreliable), will swamp base-rate information. The present studies varied differential representativeness by manipulating the degree to which the prediction categories are similar to one another vis a vis the individuating information, and hence similarly represented by that individuating information. It was found that the effect of the base rate increased systematically as differential representativeness decreased. Representativeness was measured independently by several converging techniques. These measures predicted the magnitude of the base rate over entire sets of descriptions.

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SUMMARY

When making predictions, one is often called upon to combine two kinds of information: (a) base-rate information, describing what usually happens in such situations; (b) individuating information, describing the unique features of the particular case in point. These contrasting kinds of information may be found in such varied problems as predicting whether a particular individual is likely to commit a violent act or predicting whether a particular individual will respond positively to a charity appear. In the first of these examples, the base rate might be the prevalence of violent individuals in the general population and the individuating information might be a detailed personality profile; in the second case, the base rate might be the population donor rate and the individuating information the solicitor's first impression.

The degree to which one relies on these two kinds of information should reflect the relative quality of the information that they provide. A lively controversy in the research literature has considered the extent to which people intuitively follow this normative judgmental rule. The present studies look at predictions made for tasks in which base-rate information is perfect and individuating information is given by no more than a thumbnail description of the target individuals. These descriptions vary to the extent that they allow the use of a judgmental rule known as "representativeness," according to which an individual is judged to belong to a category (e.g., violent, non-violent) whose stereotype he or she resembles. Representativeness was measured directly in a separate study.

It was found that people ignore base rates whenever they are able to rely on representativeness. When representativeness fails to provide a guide, they attend to base rates; however, they have little confidence

in their predictions. Confidence seems to be directly related to the ability to use representativeness--although there is a slight tendency to show reduced confidence when representativeness leads one to predict an event with a low base rate.

In addition to clarifying the conflicting results in the literature and to offering several converging techniques for measuring representativeness, the present study has a clear message for those interested in improving judgment: judges need to receive direct training in how to evaluate information.

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Diagnosticity and the Base-Rate Effect

A central result in the study of judgment has been Kahneman and Tversky's (1972, 1973) demonstrations of the extent to which people ignore normatively relevant base-rate information in the presence of even scanty individuating information. They attributed this "base-rate fallacy" to a judgmental heuristic called "representativeness". The user of this heuristic judges an individual's membership in a category to be likely to the extent that the individual's description reflects or "represents" the category's main features; an individual seems most likely to belong to the category whose features he or she best represents. Normatively speaking, such categorical predictions should be guided by the relative size of the categories, that is, their base rates. One may predict membership in a category that does not have the highest base rate only if one has sufficiently diagnostic evidence indicating membership in that category. Kahneman and Tversky's demonstrations, and subsequent replications (see e.g., Borgida & Brekke, in press; Eddy, in press; Nisbett & Ross, 1980), have shown that people will predict membership in very unlikely categories on the basis of evidence that they themselves (would) admit has little diagnostic value.

One of the few apparently inconsistent findings was reported by Manis, Dovalina, Avis and Cardoze (1980). Their subjects predicted the category membership of the individuals depicted in a series of pictures. These categorical predictions were found to vary with changes in the reported base rates of the categories. Although Manis et al. claimed that these data violated the representativeness hypothesis, a reanalysis by Bar-Hillel and Fischhoff (1981) showed that the changes in the distribution of categorical predictions may have occurred only in the predictions made for <u>neutral</u> pictures, ones for which representativeness fails to provide a prediction guide. Predictions for such pictures

would be governed by base rates, whereas non-neutral pictures would be judged by representativeness. Neutrality can be caused either by pallid individuating information, which represents neither category, or by more vivid information that is equally representative of all the prediction categories (Ginosar & Thorpe, 1980).

If Bar-Hillel and Fischhoff's account is correct, then the effect of base rates on categorical predictions should depend on the neutrality of the judged stimuli. The present experiments test this prediction, using the same set of written thumbnail descriptions of individuals in three different prediction contexts that differ in the extent to which the descriptions are likely to be viewed as neutral in them. It was anticipated that changes in the reported base rates would have a greater effect on subject's predictions as the descriptions' neutrality increased.

In addition to eliciting categorical predictions, the present study required subjects to indicate how confident they were in their predictions. Bar-Hillel and Fischhoff (1981) speculated that although subjects will seldom violate judgment by representativeness in order to accommodate base-rate considerations, they might still reduce their confidence in minority category predictions. Thus, for example, if a description resembles a business executive more than a university professor, one would predict "executive" even if the description came from a population with few executives. However, one would not be very confident in that prediction. Using both responses modes in this study allowed us to test this prediction.

A separate study assessed the diagnosticity (or the neutrality) of the stimuli independently.

Experiment 1

In this experiment we attempted to manipulate the extent to which a set of descriptions can be categorized according to representativeness. Three contexts were employed for this purpose. The first used two distinct categories, engineer versus lawyer, following Kahneman & Tversky (1973). We attempted to create a set of descriptions three of which would look like engineers (2, 6, 9 in Appendix A) and seven of which would look like lawyers. We labelled this the High-Diagnosticity Context. In the second, we replaced the lawyer category by one more similar to engineer, that of physicist, following Ginosar & Trope (1980). Presumably, someone who seems like an engineer is more likely to resemble a physicist than a lawyer, since physicists resemble engineers more closely than lawyers do; hence, representativeness is more likely to fail to guide predictions in this context. We labelled it Low-Diagnosticity Context I. In the third, we employed distinct categories, business executive and university professor, but attempted to increase the neutrality of the profiles by writing what seemed to us more neutral descriptions vis a vis the categories (Appendix B). We labelled this Low-Diagnosticity Context II.

Method

Design. Subjects' task was to predict the category membership of ten men described in ten shortwritten descriptions, and to indicate their confidence in those predictions. There were two sets of ten descriptions. Each description consisted of two to four short sentences, and 30 to 50 words. The sets appear in Appendix A and B, respectively. A given set was categorized into a given pair of categories under two reversed base rate conditions. For example, one group of subjects categorized Set A into the two categories engineer and lawyer after

being told that the descriptions were sampled from a population consisting of 70 lawyers and 30 engineers. Another group were told that the population consisted of 30 lawyers and 70 engineers. Set A was also categorized by two additional groups of subjects into engineers versus physicists, under a 30:70 and a 70:30 base-rate conditions. The top rows of Table 1 summarize the design of this experiment.

Instructions. Set B subjects in the 30:70 base-rate condition were told:

> A panel of psychologists have interviewed and administered personality tests to 30 business executives and 70 university professors, all successful in their respective fields. On the basis of this information, thumbnail descriptions of the 30 business executives and 70 university professors have been written. You will find on your forms ten descriptions, chosen at random from the 100 available descriptions. For each description, please:
>
> (a) Mark whether you believe the described individual is one of the 30 business executives or one of the 70 university professors.
> (b) Indicate your probability that you guessed the individual's occupation correctly.

After presentation of each profile, subjects received the following question:

I believe he is a	Business Executive	____	(check one)
	University Professor	____	

My probability that my guess is right is ____

Subjects in the other conditions received analogous instructions.

Subjects. Participants were recruited by ads in the University of Oregon student newspaper that offered $6 for participating in 1½ hours of unrelated tasks in judgment. There were altogether 155 individuals, and each of the six experimental groups had between 26 and 50 participants. The exact numbers appear in the last row of Table 1. The same individuals participated in the high-diagnosticity context and low-diagnosticity context II, since these involved different profiles and different prediction categories.

Results

Categorical predictions. Table 1 shows the predictions made for each profile by subjects in each group. The base rate had virtually no effect in the Engineer-Lawyer context. The profiles were judged quite similarly by the two groups, with an overall difference of only 0.2% in the percentage of "engineer" predictions between the two base-rate groups. In the other two contexts subjects were somewhat responsive to base rates, in the sense of reducing the proportion of their predictions of the minority category (a change of 6.8% in the Engineer-Physicist context, and 4.1% in the Executive-Professor context).

Confidence. Table 2 shows the confidence that subjects expressed in their category predictions as a function of base rate, aggregated overall ten profiles. Five of the six groups of subjects were more confident when making predictions of majority than of minority categories. The one exception was the High Engineer-Low Lawyer group, which expressed higher average confidence in the 61% of their predictions that were "lawyer" (mean confidence - .746) than in the 39% that were "engineer" (mean confidence = .702). Weighting these mean differences by the number

TABLE 1

CATEGORICAL PREDICTIONS AS A FUNCTION OF CONTEXT DIAGNOSTICITY

Profile	High Diagnosticity Context Engineer - Lawyer Set A			Low Diagnosticity Context I Engineer - Physicist Set A			Low Diagnosticity Context II Executive - Professor Set B		
	Percent Predicted as Engineers			Percent Predicted as Engineers			Percent Predicted as Executives		
	High Eng. Base Rate	High Law. Base Rate	Difference[a]	High Eng. Base Rate	High Phys. Base Rate	Difference[a]	High Exec. Base Rate	High Prof. Base Rate	Difference[a]
1	4	0	+ 4	66	63	+ 3	38	26	+12
2	100	96	+ 4	54	39	+15	81	80	+ 1
3	15	16	- 1	44	42	+ 2	62	72	-10
4	23	24	- 1	51	45	+ 6	19	14	+ 5
5	15	22	- 7	59	66	- 7	65	70	- 5
6	81	94	-13	78	76	+ 2	77	84	- 7
7	23	30	- 7	66	42	+24	35	38	- 3
8	8	20	-12	54	50	+ 4	35	26	+ 9
9	100	70	+30	41	50	- 9	62	58	+ 4
10	19	18	+ 1	73	45	+28	73	38	+35
Average	38.8	39.0	- 0.2	58.6	51.8	+ 6.8	54.7	50.6	+ 4.1
N	26	50		41	38		26	50	

[a]Positive sign means higher proportion of predictions for the higher base rate.

Note. With the present sample sizes, only the largest of these changes (> 16%) for individual profiles reach statistical significance (α = .05; one-tailed test). Over all profiles, the base-rate effect was negligible with the high-diagnosticity condition (t = 0.05; df = 74), marginal with low-diagnosticity context II (t = 1.39; df = 74) and significant with low-diagnosticity context I (t = 2.26; df = 77).

TABLE 2

MEAN CONFIDENCE IN PREDICTIONS

Base Rate Condition	Categorical Prediction		
High Diagnosticity	Engineer	Lawyer	Difference[a]
High Engineer	*.702*	.746	-.044
High Lawyer	.684	*.739*	+.058
Low Diagnosticity I	Engineer	Physicist	
High Engineer	*.672*	.629	+.043
High Physicist	.661	*.695*	+.034
Low Diagnosticity II	Executive	Professor	
High Executive	*.712*	.629	+.083
High Professor	.646	*.664*	+.018

Note: Predictions consistent with the base rate are italicized.

[a]A positive sign indicates that subjects were more confident in making predictions consistent with the base rate.

of choices involved reveals a shift of +.023 in the high-diagnosticity condition, versus shifts that are almost twice as large in the two low-diagnosticity conditions (+.039 in the Engineer-Physicist context and +.040 in the Executive-Professor context).

Discussion

Bar-Hillel & Fischhoff (1981) predicted that a series of highly representative stimuli would be classified similarly under differing base rate conditions. Table shows that this prediction was borne out. Sets of ten individual descriptions were classified in much the same way by paired groups of subjects receiving reversed (70:30 versus 30:70) base-rate information. The similarity is most striking in the high-diagnosticity condition. Even in the low-diagnosticity conditions, the distributions, though different, are actually more similar than we had expected. In other words, although the percentage of subjects who assigned a given description to a given category was typically smaller when that category was a minority one than when it was a majority one, the average difference was only 4% - 7%.

Our hypothesis that subjects would feel reduced confidence in predictions that go counter to the base-rate indication received only modest support. Pooling over all three groups, subjects' confidence estimates were lower by .034 when predicting against the base rate than when predicting with it. Another influence on confidence was diagnosticity. Subjects were somewhat more confident when making predictions in the presence of a strong representativeness guide (engineer-lawyer condition, mean confidence - .730) than in the presence of a weak one (engineer-physicist, mean confidence = .665; executive-professor mean confidence =.661).[1]

Although the effect of base rates on categorical predictions was in the anticipated direction, its magnitude was surprisingly small in the

low-diagnosticity contexts. One possible explanation is that the base rates were not sufficiently highlighted. They were mentioned in the general instructions, but were not repeated at the time that subjects made their judgments. Perhaps the base rates had already fallen out of the focus of subjects' attention (or even been forgotten) by the time that they began to evaluate individual profiles. Of course, exclusive reliance on representativeness is of interest only when subjects are aware of the base rates yet ignore them, rather than inadvertently neglect them.

According to the second explanation, the effect was small simply because our attempt to create low-diagnosticity situations was only somewhat successful. That is, the profiles were only slightly more neutral in those contexts than in the high-diagnosticity context, resulting in a slight base-rate effect.

Experiment 2 deals with both of these possible explanations.

Experiment 2

This experiment consists of a Prediction Study and a Stimulus Evaluation Study. The Prediction Study is a constructive replication of Experiment 1, using a format that stresses the base rate in every prediction question. The Stimulus Evaluation Study requires subjects to scale the similarity of the profiles to the two category stereotypes of each context, in order to measure representativeness directly.

Method: Stimulus Evaluation Study

Design. Subjects received the ten profiles of Set A, with no base rate information, and similarity judgments were elicited. In the high-diagnosticity context, subjects scaled the similarity of each profile to the pari of categories labelled "university professor" and "business executive." In the low-diagnosticity condition, the categories were "engineer" and "Physicist", and in the no-diagnosticity condition they were "dentist" and "orthodontist."

Two elicitation methods were used with the high-diagnosticity context. One presented subjects with a bipolar scale, anchored at "very similar to a business executive" and "very similar" to a university professor." The labels were reversed for half of the subjects to investigate the effects, if any, of that manipulation. The second method presented two unipolar scales, one asking how similar the individual was to a business executive, the second asking how similar he was to a university professor. Both questions followed each profile. Subjects were administered one type of scale each.

Because, as will be described in the results section, both procedures produced similar results, only the bipolar scale was used with the low-

and no-diagnosticity contexts. About half of all subjects received each order of labels.

Instructions. All subjects received the same story about the origins of the profiles as did subjects in Experiment 1, but without any mention of the base rate. After each profile, the bipolar-scale subjects in the high-diagnosticity condition were asked to:

> Circle a number on the scale below for how much the description seems to you like a business executive or how much like a university professor.

very much like a business executive	6	5	4	3	2	1	0	1	2	3	4	5	6	very much like a university professor
							neither							

Unipolar-scale subjects were told in their general instructions that for each description, they were to:

(a) Judge how much the person described seems to you like a business executive and
(b) Judge how much like a university professor.

After each profile, they were asked to:

> Circle a number on each of the scales below for how much the description seems to you like a business executive and how much like a university professor.

Not at all like a business executive	1	2	3	4	5	6	7	Very much like a business executive

Not at all like a university professor	1	2	3	4	5	6	7	Very much like a university professor

In the other conditions, analogous instructions were given.

Subjects. Participants were recruited in the same manner as in Experiment 1. Roughly equal numbers of the 220 individuals were in each of the different scaling groups.

Method: Prediction Study

Design. Subjects predicted the category membership of the ten men described in Set A, and indicated their confidence in those predictions. In the high-diagnosticity condition. About half were told that the descriptions came from a population with 30 professors and 70 executives; the other half was given the opposite base rate (i.e., 30 executives and 70 professors). *In the low-diagnosticity condition about half received* a 30:70 base-rate split and the remainder 70:30. The no-diagnosticity condition considered the two categories dentist and orthodontist, with the same two base rates.

Instructions. The same cover story was used as in Experiment 1. The difference is that each question reiterated the base rate. For example, for the high diagnosticity, high professor group, each profile was followed by the words:

I believe he is one of the 30 business executives ____ / one of the 70 university professors ____ (check one)

My probability that my guess is right is ____%.

Questions were analogously phrased for other groups.

Subjects. There were 284 individuals, recruited as in Experiment 1, divided about equally over the six experimental conditions.

Results: Stimulus Evaluation Study

High diagnosticity. The left side of Table 3 shows various aspects of subjects' responses to the 13-point bipolar scales whose initial (left-hand) label was either "executive" or "professor." The first three columns show the frequency with which each profile was indicated to be more like an executive, more like a professor, or neutral (i.e., rated 0). Such judgments will be called categorical choices.

Half of these subjects received a scale with "executive" on the left, and half received a scale with "executive" on the right. The percentage of categorical choices was very similar for all profiles. Overall, having "executive" on the left was associated with 0.2% few "executive" choices. As a result the two groups are combined in Table 3.

The high diagnosticity of this context can be seen by the low percentage of neutral judgments (8.4%). Overall, more of the profiles tended to be judged executive-like, with that category garnering 60% of all non-neutral ratings 55 /(55 +36.6) .

On the basis of subjects' ratings we may distinguish among three kinds of profiles: (a) Profiles consensually classified as executives (3,5,8, 10); (b) Profiles consensually classified as professors (4, and possibly 9); (c) Neutral profiles, these can be either profiles actually rated by subjects as 0 on the bipolar scale (6 is the most neutral in our set), or controversial or inconsistent profiles, about which subjects disagree (i.e., some rate them high as lawyers and some high as engineers with equal frequency, as in 1, 2 and 7).

TABLE 3

SCALING OF STIMULI - HIGH DIAGNOSTICITY CONTEXT

	Bipolar Scale						Unipolar Scales					
	Percentage of Choices			Mean Rating of Those Choosing			Percentage of Choices			Mean Rating of Those Choosing		
	Exec.	Neutral	Prof.	Exec.	Prof.	All[a]	Exec. Higher	No Diff.	Prof. Higher	Exec.	Prof.	All[b]
Profile 1	44	1	54	3.6	3.9	- .5	48	13	49	2.8	3.1	+ .1
2	46	7	47	4.1	3.5	+ .3	43	13	44	3.4	3.3	- .1
3	77	9	14	4.1	4.2	+2.6	63	13	24	3.7	2.3	+1.7
4	21	7	71	3.1	3.6	-1.9	35	8	57	2.6	3.6	-1.1
5	76	6	19	4.1	3.0	+2.5	68	3	29	3.2	2.7	+1.4
6	37	34	29	2.9	3.5	+ .1	40	28	32	2.9	2.6	+ .3
7	44	10	46	3.8	3.5	+ .1	50	20	30	3.1	2.3	+ .9
8	79	4	17	4.6	2.2	+3.2	78	13	9	3.7	2.5	+2.7
9	37	4	59	3.0	3.9	-1.1	43	23	34	2.6	2.3	+ .3
10	89	1	10	4.5	4.6	+3.5	80	8	12	4.0	1.8	+3.0
Mean	55.0	8.4	36.6	4.0	3.6	+1.2	54.5	13.8	31.7	3.3	2.8	+ .9

[a]Positive sign indicates a higher overall rating for executive.

[b]Positive sign indicates a higher overall rating for executive. This mean represents the single difference between the two preceding columns (prior to rounding).

For each profile, subjects who made non-neutral ratings were separated into those rating the profile as more like an executive, and those rating it as more like a professor. The next two columns in Table 3 show the mean ratings of each group for their higher rating, for each profile. The extremity of these means shows that once subjects made a categorical choice, they tended to express considerable confidence in it. The mean rating associated with all non-neutral categorical choices was 3.75 (on a 6-point scale). The next column (labelled "All"), gives the mean of all ratings for each profile, treating ratings associated with executive choices as positive and ratings associated with neutral choices as zero. As might be expected, high positive mean ratings correspond to a high proportion of "executive" choices, and high negative ones to "professor" choices. Reversal of the scale labels had little effect on this measure (not shown).

The right-hand side of Table 3 summarizes ratings on the two unipolar scales, all of which inquired about executive first. If we take cases in which both categories received the same rating to be neutral, then the percentage of neutral judgments is somewhat higher here than with the bipolar scales (13.8% vs. 8.4%). As with the bipolar scales, non-neutral choices (i.e., cases in which one rating was higher) ran about 3:2 in favor of "executive." These choice percentages were also fairly similar to those observed with a bipolar scale on a profile-by-profile basis.

The final three columns show the mean difference between the "executive" and "professor" ratings (a) for those subjects who gave a higher rating to "executive;" (b) for those subjects who gave a higher rating to "professor;" (c) for all subjects (including those who gave equal ratings). The extremity of the mean differences in the first two of these columns shows that subjects who made non-neutral judgments saw the profile as

much more representative of one profession than of the other. The mean difference between the two ratings that non-neutral stimuli received was 3.0 (out of a possible 6).

Low-and-no-diagnosticity. Table 4 parallels the left hand columns of Table 3, presenting ratings on the bipolar scales for the low-and-no-diagnosticity contexts. As in Table 3, these results are pooled from groups that received the category lables in different orders. There was no systematic difference between these groups. The profiles were judged more neutrally in these contexts. The rate of "no difference" responses was almost three times as large in low-diagnosticity as in the high-diagnosticity context (24.0%), and almost four times as large in the no-diagnosticity context (31.5%). Among subjects who made non-neutral ratings, the mean overall rating was 3.2 in both no-and-low-diagnosticity condition. (The profile-by-profile means are not shown). Thus, although the present judgments were somewhat less polarized than those in the high-diagnosticity condition, those subjects giving non-neutral ratings still made fairly extreme discriminations between the two categories being judged.

Results: Prediction Study

Categorical predictions. Table 5 is analogous to Table 1 above. It shows the predictions made for each profile by subjects in each group. In all three contexts, subjects were responsive to base rates, in the sense of reducing the proportion of their predictions of the minority category. As predicted, the effect was largest in the no-diagnosticity context (a change of 12% on average), and smallest in the high-diagnosticity context (a change of 4.5% on average), with the low-diagnosticity context in between (a change of 8.7% on average).

TABLE 4

SCALING OF STIMULI -- LOW DIAGNOSTICITY AND NO-DIAGNOSTICITY CONTEXTS

PERCENTAGE OF CHOICES

		Low Diagnosticity			No Diagnosticity		
		Eng.	Neutral	Phys.	Dentist	Neutral	Ortho
Profile	1	43	22	35	32	40	28
	2	54	6	40	47	21	32
	3	33	35	32	19	38	43
	4	21	[illegible]	48	30	38	32
	5	25	29	46	38	26	36
	6	52	19	29	38	36	26
	7	49	22	29	32	17	51
	8	44	29	27	34	43	23
	9	48	11	41	38	21	41
	10	38	35	27	38	34	28
Mean		40.8	24.0	35.2	34.7	31.5	33.8

TABLE 5

CATEGORICAL PREDICTIONS AS A FUNCTION OF CONTEXT DIAGNOSTICITY

Profile	High Diagnosticity Context Percent Predictions of Executives			Low Diagnosticity Context Percent Predictions of Engineers			No Diagnosticity Context Percent Predictions of Dentists		
	High Exec. Base Rate	High Prof. Base Rate	Difference[a]	High Eng. Base Rate	High Phys. Base Rate	Difference[a]	High Dent. Base Rate	High Ortho. Base Rate	Difference[a]
1	53	48	+ 5	80	70	+10	54	32	+22
2	53	59	- 6	55	41	+14	59	51	+ 8
3	72	75	- 3	43	46	- 3	65	47	+18
4	47	30	+17	45	28	+17	43	40	+ 3
5	89	73	+16	65	46	+19	57	51	+ 6
6	68	57	+11	88	72	+16	50	49	+ 1
7	47	43	+ 4	58	46	+12	50	38	+12
8	77	84	- 7	70	67	+ 3	68	42	+26
9	45	36	+ 9	43	50	- 7	52	51	+ 1
10	85	86	- 1	60	54	+ 6	50	26	+24
Average	63.6	59.1	+ 4.5	60.7	52.0	+ 8.7	54.6	42.6	+12.0
N	47	44		40	46		54	53	

[a]Positive sign means a higher percentage of predictions for the category (executives, engineers, or dentists) when its base rate was reported to be larger.

Note. With the present sample sizes, only the largest of these changes (> 16%) for individual profiles reach statistical significance (α = .05; one-tailed test for difference of proportions). The number of executive choices per subject was significantly higher in the high executive base-rate condition (t=1.77; df.=89; p < .05), as was the number of engineer choices per subject in the high engineer base-rate condition (t=3.16; df.=84; p < .001), and the number of dentist choices in the high dentist base-rate condition (t=4.84; df.=105; p < .001).

The numbers in this table correspond well with analogous numbers obtained in the Stimulus Evaluation Study. Thus, in Table 3.60% of all non-neutral evaluations were "executive," while in Table 5 we see that about 60% of all predictions were "executive." On a profile-by-profile basis, profiles judged to be executives in the Stimulus Evaluation Study were typically predicted to be executives in the Prediction Study. For example, profile 5 is rated by 76% of the bipolar-scale subjects as more like an executive (column 1, Table 3), and is predicted to be an executive by 89% and 73% of the subjects in the two base-rate conditions of the high-diagnosticity context (columns 1 and 2, Table 5).

The results in Table 5 are comparable to those in Experiment 1. The low-diagnosticity condition here employed the same profiles and categories as the low-diagnosticity context I there. Apparently, stressing the base rate enlarged the size of the base-rate effect somewhat (from 6.8% there to 8.7% here). The effect in the high-diagnosticity condition here is larger than in the high-diagnosticity condition there, which may be due either to the stressing of the base rate, or to the fact that the profiles in Set A were actually designed to distinguish between engineers and lawyers rather than between executives and professors.[2]

<u>Confidence</u>. Table 6 is analogous to Table 2 above. It shows the confidence that subjects expressed in their category predictions as a function of base rate, aggregated over all ten profiles. Here, too, five of the six groups of subjects were more confident when making predictions of majority than of minority categories. The one exception was with the high professor base-rate group, which was more confident in the 59% of their predictions that were "executive" (mean confidence = .752) than in the 41% that were "professor" (mean confidence = .713). Weighting these mean confidences by the number of choices involved reveals a shift of +.056 in the no-diagnosticity, and a shift of +.050 in the low-diagnos-

TABLE 6

MEAN CONFIDENCE IN PREDICTIONS

		Categorical Prediction		
High Diagnosticity		Executive	Professor	Difference[a]
Base Rate Condition	High Executive	*.753*	.705	+.048
	High Professor	.752	*.713*	-.039
Low Diagnosticity		Engineer	Physicist	
Base Rate Condition	High Engineer	*.643*	.567	+.076
	High Physicist	.635	*.671*	+.036
No Diagnosticity		Dentist	Orthodontist	
Base Rate Condition	High Dentist	*.630*	.583	+.047
	High Orthodontist	.555	*.621*	+.066

Note: Predictions consistent with the base rate are italicized.

[a]A positive sign indicates that subjects were more confident in making predictions consistent with the base rate.

ticity contexts, compared with a shift of only +.014 in the high-diagnosticity context. Hence, from this perspective, too, subjects were more responsive to base rates in the low-diagnosticity and no-diagnosticity contexts. The greater differential representatives of profiles in the high-diagnosticity condition is also reflected by the overall level of confidence there (.736, .633, and .593 in the high-, low-, and no-diagnosticity conditions, respectively).[3]

GENERAL DISCUSSION

Experiment 2 provides us with an independent evaluation of how successful we were in creating contexts of varying diagnosticity. Our success may be seen from the Stimulus Evaluation Study. The proportion of neutral judgments increased from 8.4% in the executive-professor condition, to 24.0% in the engineer-physicist condition, to 31.5% in the dentist-orthodontist condition. The failure of this attempt is apparent in the high rate of non-neutral judgments, even in what we had hoped would be a no-diagnosticity condition. It may also be seen in the extreme ratings given by those subjects who made non-neutral evaluations.

This failure calls to mind a related failure encountered by Fischhoff and Slovic (1980). These investigators attempted to present subjects with a discrimination task that would be all but impossible, but for which some spurious cue might be offered. They were unable to devise such a task that would lead subjects to lose all confidence in their ability to make the required discrimination. Such results suggest that in some contexts, indiscriminable categories may be a rarity. When asked to do so, people may be able to find a basis for sorting a profile into one of any two categories with some confidence.[4]

As predicted, the base rate had more effect on subjects' categorical predictions as the percentage of neutral stimuli increased. As in Manis et al. (1980), this effect was achieved with a simple summary statement of the base rate, repeated at the time of each judgment. Thus, in the high-diagnosticity condition, there were overall 4.5% more "executive" predictions when executive was the majority category than when it was the minority category. This proportion increased to 8.7% and 12.0% in the low-and no-diagnosticity conditions, respectively.

These numbers allow some speculation about how subjects classified neutral stimuli. Had they classified all neutral stimuli into the majority category, then the magnitude of the base-rate effect (i.e., the difference between the proportion of predictions classifying stimuli into a given category when it is a majority one and when it is a minority one) would have equalled the proportions of neutral profiles (i.e., 8.4%, 24%, and 31.5%, instead of the observed 4.5%, 8.7%, and 12%, respectively). Alternatively, subjects may probability match on the neutral stimuli; that is, they may classify 70% of them into the 70% category, and 30% of them into the 30% category, as suggested by Bar-Hillel and Fischhoff (1981). In the high-diagnosticity condition, for example, the 8.4% neutral stimuli would thereby be divided into 5.9% executive versus 2.5% professor in the high-executive base-rate condition; in the low-executive base-rate condition these percentages would be reversed, producing a 3.4% (5.9% - 2.5%) base-rate effect. Similarly, strict probability matching would product base-rate effects of 9.6% and 12.6% in the low-and-no-diagnosticity conditions, respectively. These predicted numbers are similar to the observed values of 4.5%, 8.7%, and 12%, respectively.

The results of Experiment 2 enable us to evaluate the two tentative explanations put forth in the Discussion of Experiment 1. Explanation (b) has now been tested and confirmed. The base-rate effect is a modest one only because the low-diagnosticity conditions are only modestly less diagnostic than the high-diagnosticity ones. The first explanation, on the other hand, has been ruled out. The Prediction Study of Experiment 2 stressed the base rate before every prediction, preventing it from being forgotten. Yet the size of the effect obtained was similar to that of Experiment 1. Furthermore, this size of effect is roughly what one would expect from probability matching on neutral stimuli, given the prevalence of such stimuli revealed by the Stimulus Evaluation Study. Thus, we believe that in both experiments base rates were used when and only when representativeness failed to guide prediction.

Subjects' confidence in their predictions was directly related to their ability to rely on representativeness. Mean confidence varied from .74 in the high-diagnosticity condition of Experiment 2 to .59 in the no-diagnosticity condition of Experiment 2. There was a slight tendency for confidence to decrease when the dictates of base rates and representativeness conflicted.

The Stimulus Evaluation Study shows that different measures of similarity yield compatible results. Moreover, it is important to obtain such independent assessment of differential representativeness (or diagnosticity). Our own intuitions led us to overestimate the neutrality of our stimuli in some cases. Indeed, our high-, low-, and no-diagnosticity conditions might be better called high-, less high-, and even-less-high-diagnosticity conditions. By choosing increasingly similar prediction categories one can expect diagnosticity to decrease, but one cannot anticipate the precise extent of that reduction.

It would have been nice to see whether the size of the base-rate effect for individual profiles is also related to the extent of their neutrality. Within the three diagnosticity conditions in Experiment 2, the correlations between the base-rate effect and the proportion of "neutral" judgments were minimal. However, these measures are too unstable for these correlations to be taken seriously. Indeed, we correlated the base-rate effect for the ten profiles of Set A as obtained in the Engineer-Physicist conditions of Experiment 1 with those of Experiment 2. The rank correlation (gamma) was zero. On the other hand, in the more reliable group there was a clear relationship between the prevalence of neutral stimuli and the size of the base-rate effect.

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Footnotes

[1] With the response mode used here, one's probability should never be less than .5. This rule was violated by Experiment 1 subjects in 6.0% of their predictions. The proportion of such unduly low confidences increased as overall confidence decreased, that is, as diagnosticity decreased.

[2] This base-rate effect is comparable to the one reported by Kahneman and Tversky (1973, p. 242). Their subjects received five descriptions under the same base rate conditions as those used here (30:70 / 70:30), with a highly diagnostic context. They found a base rate effect of 5%.

[3] In this experiment, 6.7% of the confidence values were less than .5, a rate similar to the 6.0% observed in Experiment 1 (see footnote 1). Again, this proportion increased as diagnosticity decreased.

[4] One subject wanted to know after the experiment was over whether the orthodontists were the people who seemed more mellow in their profiles.

APPENDIX A

1. John is a 30-year-old man. He is married and has two children. He is active in local politics. The hobby he most enjoys is rare stamp collecting. He is competitive, argumentative, and articulate. (a)

2. Jack is a 45-year-old man. He is married and has four children. He is generally conservative, careful, and ambitious. He shows no interest in political and social issues and spends most of his free time on his many hobbies which include home carpentry, sailing, and mathematical puzzles. (a)

3. Twice divorced, James spends most of his free time hanging around the country club. His club house bar conversations often center around his regrets at having tried to follow his esteemed father's footsteps. The long hours he had spent at academic drudgery would have been better invested in learning how to be less quarrelsome in his relations with other people.

4. Lowell often toys with his Phi Beta Kappa key during those quiet moments in which he is able to sit alone in his office. At times, in such moments, his assistant would catch him humming his favorite aria or leafing through newly acquired books on gourmet cookery.

5. In some ways, Perry's life had hit its peak 20 years ago when he headed the debating team at the private Eastern college to which the men in his family had always gone. The orderliness and gentility of those battles (in which he had been eminently successful) failed to prepare him for the harsher struggles (and frequent defeats) out in the real world.

6. Weekends are made for tinkering, Bill used to say. Over the years, he had shifted from avocation to avocation, eventually coming back to some form of electronics. Getting him going in ham radio had been the best (maybe even the only good) thing his dad had done for him.

7. Hugh took some substantial pride in the care he had taken to preserve his family's traditions. Indeed, even after he would be gone, his will laid precise plans for how his children would be educated, and as far as he could exert control, what they would choose as appropriate courses of study.

8. Probably the most relaxing time of John's week was his Monday afternoon haircut and massage. For at least an hour, there was no staff to manage, no civic organizations to address, no arguments to rehearse. All he had to do was listen to the barber's amiable chatter about his week of TV watching.

9. Tom is of high intelligence, although lacking in true creativity. He has need for order and clarity, and for neat and tidy systems in which every detail finds its appropriate place. His writing is rather dull and mechanical, occasionally enlivened by somewhat corny puns and by flashes of imagination of the sci-fi type. (a)

10. Every Sunday night, Andrew would promise himself that next weekend he would spend more time with the kids and not worrying about investments, tax shelters, and municipal bonds. He should be able to do all his financial planning during the long commute to and from the city, but always seemed to find himself embroiled in debates about foreign affairs or the theatre.

(a) Profiles taken from Kahneman and Tversky (1973).

APPENDIX B

1. Andrew grew up on a small farm in Iowa. The first of his family to go to college, he nevertheless often misses life on the farm. Though he has a stable income, he sentimentally still grows his own vegetables.

2. Although highly successful, Steve is bored with his job and regrets having lived his whole life in the same town. He likes to read mystery novels and is an avid jogger.

3. David is an ebullient, effervescent extrovert. He is always the life of the party wherever he goes. He used to be a real womanizer, but since his recent marriage has turned into a devoted family man.

4. Jeff is a great outdoor buff and spends much of his free time camping. He communicates well with his five children and his old parents, whose only child he is.

5. Hank, the son of a textile worker, labored hard to earn his way through school and learn a profession. Having adopted a child, he is today actively involved in a volunteer adoption agency.

6. Jerry ran away from his middle class home as an adolescent, but is today a conservative, responsible, hard-working professional, who recently moved to accept a better position.

7. Mark is basically lazy. He works to live, not lives to work. He and his wife, a successful photographer and ex-debutante, intend to retire early, and move out to the country as soon as their kids finish school.

8. Max, older looking than his 43 years, travelled extensively in his twenties, and speaks three languages fluently. Once a heavy drinker, he went on the wagon after his oldest child was run down in an accident.

9. Bob is very handsome in a rugged sort of way. He is always well dressed and neat to a fault. As a child, he had some difficulties in school, but blossomed in his college years.

10. Dick is a 30-year-old man. He is married with no children. A man of high ability and high motivation, he promises to be quite successful in his field. He is well liked by his colleagues. (a)

(a) Profile taken from Kahneman and Tversky (1973).

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